

Future Force Warrior (FFW) Integrated Analysis

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**The Science Behind the
Warrior:
Yesterday, Today and**



Topics

- **FFW Integrated Analysis Process**
- **Analysis Results To Date**



Integrated Analysis - Objectives

- **Assess Future Force Warrior System of Systems Combat Effectiveness**
 - **Matériel Approaches (Hardware, Software)**
 - **Cost, Weight, Cube, & Power Benefit Analyses**
 - **Distribution of Capabilities**
 - **FFW Small Combat Unit/Team Organization**
 - **Tactics, Techniques, and Procedures**
- **Recommend Operational and System of Systems Architecture Based on Combat Effectiveness Analysis**



Integrated Analyses - Process Basics

FFW User Needs

FFW Exit Criteria

Capability Description Documents (CDDs)

Essential Elements of Analysis

Combat Vignettes

Measures of Effectiveness

Measures Of Performance

Configuration Managed Spreadsheet With CDD References

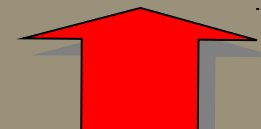
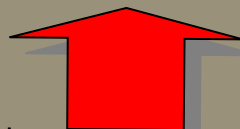
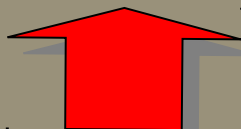
Source Document (O&O, ORD)	ISSUE	EEA	MOE	MOP
	Combat Power - Mobility Overmatch			
	Issue: 2.4.0 How does the family of systems enable mobility overmatch? (Mobility)			
O&O Ch 6.1.1.5		EEA: 2.4.1 What combined vertical and inherent horizontal maneuver qualities enable the FCS family of systems to support operational maneuver directed by the JTF commander? (Vertical & Horizontal maneuver qualities)		
O&O Ch 6.1.3.1.10			MOE: 2.4.1.1 How will the FCS family of systems have unsurpassed mobility over operational distances up to 400 km?	MOP: 2.4.1.1.1 Time, How long from mission start until the unit arrives and is ready to begin the assault mission? MOP: 2.4.1.1.2 Asset Expenditure, CS/CSS support required, losses due to transport, Aircraft by type being used, maintenance required. MOP: 2.4.1.1.3 Safety, Which COA best protects the assault force from enemy activity during transit?
O&O Ch 6.1.3.1.9		EEA: 2.4.2 How will the FCS equipped family of systems have superior tactical mobility without compromising unit integrity? (Tactical Mobility)		
O&O Ch 6.1.3.1.9			MOE: 2.4.2.1 FCS ensures superior tactical mobility in a wide assortment of terrain and weather variables, with various unit sizes.	MOP: 2.4.2.1.1 Max slope FCS family of systems can climb on a dry, hard surface. MOP: 2.4.2.1.2 Max slope FCS family of systems can descend on a dry, hard surface. MOP: 2.4.2.1.3 Max slope FCS family of systems can laterally traverse on a dry, hard surface. MOP: 2.4.2.1.4 Rapid dash speed for cover to cover moves, % of mission time spent in dash speed. MOP: 2.4.2.1.5 Clears vertical obstacles of 2.8m. MOP: 2.4.2.1.6 Number of updates/ FRAGOs per 50 km caused by lack of unit integrity.
O&O Ch 6.13.1			MOE: 2.4.2.2 Mounted and dismounted FCS elements maintain constant mutual situational awareness.	MOP: 2.4.2.2.1 Ability of system to be airdropped. MOP: 2.4.2.2.2 Time of employment of dismounted forces following dismount. Time of link-up with and remounting of vehicles. MOP: 2.4.2.2.3 Percent of time vehicle occupants have situational awareness of a 360 degree horizontal arc around the vehicle immediate surroundings.



Overarching Essential Elements of Analysis

2.4 Lethality

Can FFW ...simultaneously synchronize and use a combination of line of sight, beyond line of sight, and non-line of sight effects...more effectively and efficiently engage targets?



1.4 Situational Awareness

Can FFW ...collect, filter, fuse, and disseminate relevant situational awareness (SA) information ...to see first, understand first, act first, and finish decisively?

3.8 Sustainment

Can FFW ... operate autonomously for 24 hours (threshold), 72 hours (objective)?

5.1 Mobility

Can FFW...move freely in all types of terrain and environments?



Integrated Analysis - Vignettes

- **Based on Defense Planning Guidance Compliant Scenarios and Unit of Action Operational and Organizational Plans**
 - **Provide Operational Context for Evaluation of FFW**
-
- **Military Operations Urban Terrain Dismounted 24 Hour Mission:**
 - **FFW Platoon (Supported by Unit of Action Assets) Seizure of a Building, Deliberate Defense Against Dismounted and Mechanized Enemy, Reaction to Unexpected Contact**
 - **Jungle Dismounted 5 Day Mission:**
 - **Reconnaissance, React to Contact, Hasty Attack, Movement to Objective, Clearing Cave Complex, Movement to Ambush Locations, Ambush, Transition**



Integrated Analysis - Vignettes (cont'd)

- **Mounted Supported By Dismounted Mission:**
 - Infantry Platoon Mounted Movement to Attack Objective
 - Infantry Platoon Transition From Deliberate Attack to a New Mission
 - Dismounted Infantry Squad Clearing a Danger Area and Assault of an Enemy Position

- **Stability and Support Operations Mission**
 - Humanitarian Relief Requiring Convoy and Distribution Operations
 - Checkpoint Operations
 - Cordon and Search Operations
 - Sniper/counter-sniper Operations
 - Immediate Reaction Operations



Integrated Analyses - Concept

Essential Elements of Analysis (EEA) & Vignette

We Need to Know

Are the capabilities worth exploring?

Do they provide the > 10X benefit?

Do they work in the field?

Will the user use them?

Exploratory Analyses

Soldier in the Loop Analyses

Field Experiments

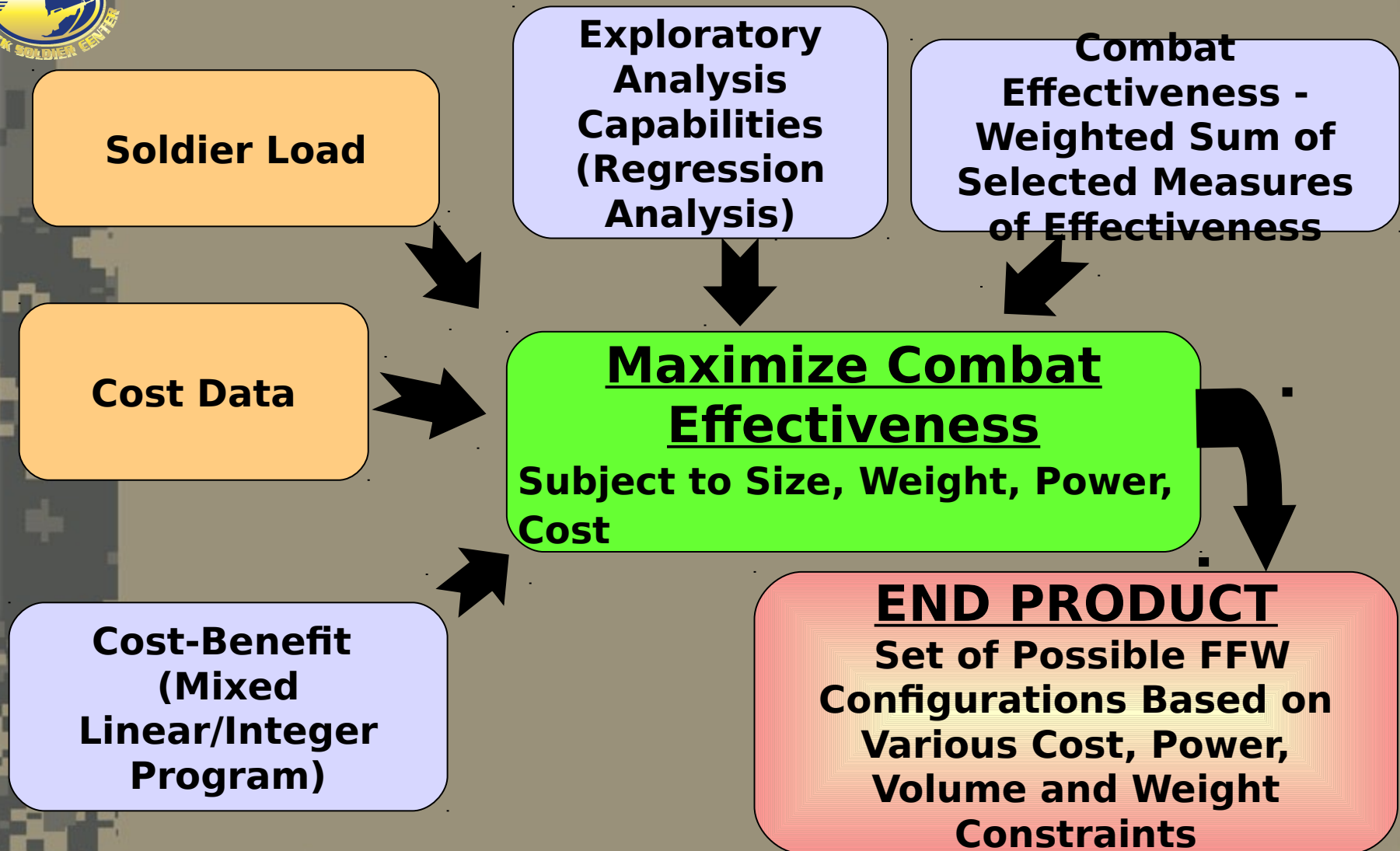


FFW System of Systems Specification

Capabilities That Work



Integrated Analysis – Benefits Approach





Integrated Analyses Activities

Map Exercise I - Oct 03

**Soldier In the Loop I -
Nov 03**

Map Exercise II - Apr 04

**Power/Energy Analysis I -
Apr 04**

Map Exercise III - Jul 04

**Power/Energy Analysis II
- Jul 04**

**Exploratory Analysis I -
Sep 04**

***Exploratory Analysis II -
Apr 05***

Cost Benefit I - Apr 05

P/E Analysis III - Apr 05

Weight Analysis I - Apr 05

**Soldier In the Loop II - Jun
05**

Cost Benefit II - Jun 05

**Power/Energy Analysis IV-
Jun 05**

Weight Analysis II - Jun 05

**Early User Experiment -
Nov 05**

- **Completed**
- ***In Progress***
- **Planned**



Topics

- Integrated Analysis Process
- Initial Analysis Results to Date
 - **Infiltration Portion of the Military Operations Urban Terrain Vignette**
 - **Power Results from Map Exercise II (Military Operations Urban Terrain) and Map Exercise III (Jungle)**



Analysis Results Matrix to Date

	<u>Lethality</u>	<u>Situational Awareness</u>	<u>Mobility</u>	<u>Sustain (Power)</u>	<u>Survivability</u>
Systems of Systems Employment	+				+
Cooperative Engagements / Fire Control	+	+	+		
Fused Vision Sensors	+	+	+		+
UAVs Workload / TTPs	+ ?	+ ?	+ ?	?	
Sensor Coverage		+ ?			+ ?
Communications	+ ?	+ ?		?	
	Benefit +	Challenge ?	Future Effort +		



Analyses Summary: System-of-Systems Employment

- **Observation: Substantially More Improvement in Combat Effectiveness vs. Any One Technological Capability by Itself (e.g., Squad-level Robotics, Improved Body Armor, Fused Sensor, etc.)**

- **Example: Simultaneity of Tactical Operations**
 - **Three Simultaneous Entry Points in Clearing a Building**
 - **Made Feasible Via the User Defined Operational Picture (UDOP) Down to Individual Soldier**
 - **Instrumental in Improving Lethality, Survivability and Mission Accomplishment Times in the Soldier-in-the-Loop Exercise.**

Derived from Map Exercises I & II, Soldier In the Loop I



Analyses Summary: Cooperative Engagements

- **Grenadiers With a Fire Control System to Enable Cooperative Engagement By the Small Combat Unit**
 - **Mission Accomplishment Time Is Reduced Vice Waiting for an NLOS Mortar Fire Mission**
 - **However, Average Blue Casualties Increased Because of Fratricide During a Particular BLOS Engagement in Some Runs**
 - **Note, Greater Influence of FFW Lethality Systems on Operational Effectiveness Is Expected During the More Intense Combat Segments of the Vignettes**



Analyses Summary: Fused Vision Sensors

- **Soldiers Moved Faster With the Helmet Mounted Fused Sensor (Short Wave/Long Wave Infrared - Vice Image Intensification on Non-leaders)**
 - **Mission Accomplishment Time Decreased**
 - **Survivability Increased During Movement and Maneuver**
 - **Attributed to Improved Mobility / Movement Rates**
 - **Mission Effectiveness Due to Increased Target Detection Capability Was Not Measured in This Analysis**
- **However, Increased Soldier Mobility Increases UAV Controller Separation From the Platoon - Time for UAV Controllers to Complete Tasks Effects Operational Tempo**



Analyses Summary: Communications

- **Observation: FFW Will Depend Heavily on Communications.**
 - **Example: Platoon Leader in 5-day Jungle Operation Sent Over 8000 Radio Messages.**
 - **Observation: FFW Will Depend Heavily on Communications Because of Increased Reliance on User Defined Operational Picture and Blue-force Tracking for Enhanced Situational Awareness.**
 - **Observation: Haptic Message Types Need to Be Defined. Some of the Increased Communications Burden May Be Mitigated by Defining Common Messages (e.g., “Roger, Out”) As Haptic Messages.**
 - **Note: Additional Analysis of Communications Capabilities Is Pending.**

Derived from Map Exercise III



Analyses Summary: Power

- **Soldiers - 200 Watt-hours for 24 Hour MOUT Vignette**
- **Leaders and Soldiers Controlling Robots Need Approximately 700 Watt-hours (next slide)**
 - **Up to 1100 Watt-hours Max for 24 Hours of Combat Operations in Military Operations Urban Terrain Vignette.**
- **Jungle Vignette Results Appear Similar**
- **Higher Fidelity Profiles Will Be Produced As Part of Exploratory Analysis Part II (Results April 2005).**

Derived from Map Exercises I & II



Analyses Summary: 700 Watt Hours Battery Options

Type	Count	Weight (lbs.)	Vol. (cu.in.)	Purchase Cost (\$) / Mission Cost Per Soldier
Disposable				
E91, AA, Alkaline	636	32	445	89 / 89
D-Cells, LiMnO ₂ (Land Warrior)	5	8.6	175	500 / 500
Rechargeable				
103450, Li-Prismatic - FFW Candidate	10	10	143	1400 / 7
18650, Li-Ion (Land Warrior)	5	11.2	199	1750 / 8
Hybrid Candidate for FFW				630 / 360
103450, Li-Prismatic Rechargeable	2	2	29	280
Prismatic, Zn-Air Primary	2	<6.6	108	350



Analyses Summary: Small Combat Unit Sensor Coverage

- **Improved Sensor Coverage Provided by Two Class I Unmanned Aerial Vehicles (vs. 1) Has a Strong Benefit in Reducing Friendly Casualties**
 - **Platoon Avoided Unwanted Enemy Contact**
 - **Mission Accomplishment Time Reduced**
 - **Other Sensor Combinations and Capabilities Still Need to Be Studied**
- **Class I Unmanned Aerial Vehicle 50-minute Mission Endurance Not Enough for Engagements During Initial Infiltrations**
 - **Two Are Needed for Continuous Coverage**



Analyses Summary: Resources to Control UAVs

- **When Two Unmanned Aerial Vehicles and Two Controllers Are Present, One Can Control While Other Moves.**
 - **Operational Risk Reduced Because Nearly Continuous Unmanned Aerial Vehicle Sensor Coverage Is Possible**
 - **Situational Awareness Improves**
 - **Mission Accomplishment Time Is Reduced**
 - **“Individual Risk” Is Increased Due to Separation of Robotics Non-commissioned Officers From Platoon While They Bound (“Leap-frog”)**
 - **Tactical Trade-offs: Increase Operational Risk by Not Flying Unmanned Aerial Vehicles As Much, or Reduce Available Combat Power by Assigning a Security Team to the Unmanned Aerial Vehicle Controllers**



Integrated Analyses - Path Forward

Essential Elements of Analysis (EEA) & Vignettes

We Need to Know

Are the capabilities worth exploring?

Do they provide the > 10X benefit?

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Capabilities That

- ***Exploratory Analysis Part II (April '05)***

- ***Cost-Benefit Analysis (April '05)***

- ***Weight-and-Cube Analysis (April '05)***

- ***Soldier-In-The-Loop Analysis (Summer '05)***

- ***Broaden Focus to Consider More Intensive Offensive and Defensive Combat Situations***



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